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## DOE-OE FY12 Electrical Energy Storage Demonstration Projects

Presented by Dan Borneo

The Renaissance Hotel Washington, D.C. September 2012





Sandia National Laboratories is a multi-program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

### Acknowledgements





I would like to thank the DOE's Office of Electricity and Dr. Imre Gyuk, Program Manager of the Electrical Energy Storage Program, for their support and funding of the Energy Storage Demonstration Projects.

# EES Emerging Technology Demonstrations Presentation Outline





- Project Overview
- Problem Statement
  - Approach
  - Current Status
  - Path Forward Next Steps
- Geographical Representation of Projects
- Summary Chart of Projects
- Brief Descriptions of Individual Projects
- Concluding Remarks

#### **EES Demonstrations Project Overview**





- Problem Statement
  - To encourage investment in electrical energy storage that impacts services critical for the next generation grid, it is important to develop the proper test platforms, collect meaningful data, and work with analysts and engineers trained in different environments, to understand how to satisfy requirements related to the variety of emerging energy storage technologies & applications.
- Approach = Deliverables
  - Use grid-tied field demonstration projects to test and evaluate new and existing ESS technologies in different settings
  - Provide third party independent testing and analysis
- Current Status (Provided later in Individual Reports)
- Path Forward
  - Work to support vendor utility understanding of the role EES can play to be effective in various grid services and applications.
  - Continue to use independent evaluations of EES to validate and encourage commercialization of new technologies.

# Locations of DOE-OE EES Demonstration Projects in this Presentation





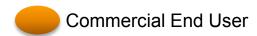


Legend:



CESA DoD





#### Summary Snapshot of EES Demo Projects





| Location      | Name                                      | Technology/Set-up   | Environment/Application           |
|---------------|---|---|-----------------------------------|
| Massachusetts | Fort Devens Systems Integration Lab (SIL) | 2-4 Vendors & Varied Technologies/Military Nanogrid                                   | Forward Operating Base            |
| Hawaii        | Fort Hickam                               | Zinc Bromide/Military Microgrid   | Military Base                     |
| California    | SunPower                                  | Zinc Bromide & ICE Energy/<br>Renewable - PV  | Commercial Application            |
| California    | University of California at San Diego     | TBD/Microgrid and Renewables - PV   | University Campus                 |
| Texas         | Texas Tech University                     | TBD/Renewables - Wind   | University & Industry Testbed     |
| New Mexico    | Mesa del Sol                              | Lead Acid – GS, EP; Fuel Cell/<br>Microgrid with local Generation;<br>Renewables - PV | Commercial and residential        |
|               | Clean Energy States Alliance              |   |                                   |
| Vermont       | TBD                                       | TBD   | TBD                               |
| Alaska        | ZBB                                       | Zinc Bromine/Microgrid  | University Testbed Facility       |
| Pennsylvania  | Aquion Energy                             | Aqueous Sodium; Grid-Tied   | Industrial Manufacturing Facility |
| New Hampshire | SustainX                                  | ICAES; Grid-Tied  | Industrial Manufacturing Facility |
| TBD           | Enervault                                 | Iron Chrome/TBD   | TBD                               |

#### Fort Devens: BCIL / Forward Operating Base (FOB)







60KW TACTICAL QUIET GENERATOR (TQG) MICRO-GRID (FY11 & 12) ENVIRONMENTAL CONTROL UNITS (ECU) (FY12)



Image source: http://www.army.mil/article/60473

#### **Base Camp Integration Lab**

- Project Scope EES demonstration in Forward Operating Base (FOB) application. FOB consists of 6-60KW gen sets serving 150-man base camp.
- Goal Provide technical consulting and third party evaluation to the Army to incorporate energy storage into FOB microgrid with objective of reducing the generator fuel usage.
- Current Status RFI issued and submittals received to provide EES systems for evaluation.
  - Testing first at Sandia, and then at BCIL,
     Ft. Devens

#### Path Forward

 Down select Review RFI submittals and invite vendors to test their system at Sandia first and then Ft. Devens

#### Pearl Harbor – Ft Hickam: Joint Base SPIDERS Microgrid Demonstration Project











Permission granted for use of image by Project Lead, US Army Corps of Engineers, ERDC-CERL



View of Hickam Air Force Base Beach.
Photo by Fred Farrell

- Project Scope As part of the SPIDERS program, Fort Hickam is receiving a ZBB, 400KWh Electrical Energy Storage system to include in their (SPIDERS) microgrid.
- Goal Analyze system and the various components to develop optimization strategies.
- Current Status Delivery of system scheduled for September/October 2012.
   Installation to be completed mid to late October. Commissioning estimate to start November timeframe.
- Path Forward Installation,
   Startup/Commissioning, operation,
   system evaluation and analysis.

#### SUNPOWER







http://www.google.com/search?num=10&hl=en&site=imghp&tbm=isch&sourcehp&biw=1241&bih=806&q=SunPower&oq=SunPower&gs\_l=img



Image source: http://www.yelp.com/biz\_photos/siNxEpLbxqAuy0DsnHJa6A?select= O4SzLJ4BOqiJzKsiFMOEQ#NqSvan2J87osXss2XE4n8g

- Project Scope The Project will install energy storage systems on existing PV systems at two separate locations in California.
  - Thermal energy storage: Ice Energy at Kohl's Department Store in Redding, coordinated with Redding Electric Utility.
  - Electric energy storage: ZBB flow-battery at to-beannounced Silicon Valley hi-tech manufacturing company.

#### Goals

- Identify and measure potential synergistic economic benefits of combined PV and ES installations in commercial applications (customer's side of the meter).
- Provide technical consulting, data collection, analysis and issue report of findings in collaboration with DNV-KEMA..
- Project Status Ice Energy: Installation under way;
  ZBB: Design and permitting under review.
- Path Forward Engage Ice Energy and ZBB (with DNV-KEMA) for baseline and operational testing.

#### University of California at San Diego







Image source: http://www.borregosolar.com/solar-projects/education/university-of-california-san-diego/



- Project Scope OE/Sandia will collaborate with UCSD as they procure 3.6 MW of electrical energy storage. The Project will install EES systems on existing PV systems and in a stand-alone application.
- Goal Determine how EES can benefit a microgrid environment.
- Current Status Project to start October 1, 2012.
- Path Forward Engage with University facility team; develop specifications; review submittals for energy storage system.

#### Texas Tech University EES Project





- Project Scope Sandia/DOE will evaluate electrical energy resources on a wind test site being developed with Sandia, TTU and industry.
- Goal Establish site-specific EES benefits for this Wind installation.
- Current Status Kickoff meeting held and work is expanding to specify energy storage system.
- Path Forward Identify and procure energy storage system.



Image source: http://www.depts.ttu.edu/weweb/



#### Mesa del Sol - A Planned Community





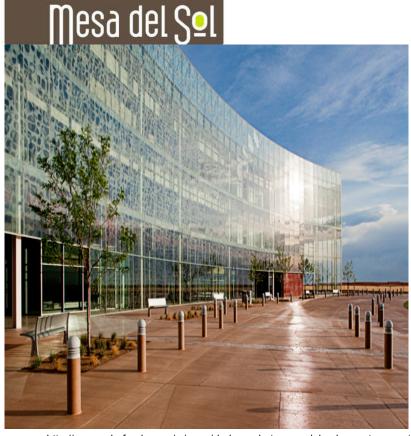


Image source - http://www.solarfeeds.com/microgrid-planned-at-mesa-del-sols-aperture-center/

- Project Scope Conduct analysis of new and existing systems installed at Mesa del Sol to minimize power while extending storage lifetime. The proposed system includes PV, energy storage, gas generators, and fuel cells.
- Goal Analyze the complete system under different control strategies; review MDS with varying coordination levels to optimize control strategies.
- Current Status Preliminary modeling using a natural gas gen set to optimize storage life and smooth PV output completed.
- Path Forward Complete modeling.
   Develop test plan to verify and validate modeling results.

#### **CESA EES Demonstration Projects**







Info from the CESA website

#### **Core Membership Information**

**Eligible entities**: States, cities, other sub-national entities that administer public dollars for clean energy, and publicly owned utilities - provided that the program makes funding available to the public for clean energy projects, market building, or related activities.

**Services:** Full members will receive the full complement of current CESA services, including Members-Only monthly webinars, biannual meetings, peer-to-peer listserv, cutting-edge analysis, direct consulting services, media support, priority project participation, and governance rights.

#### **CESA Projects Status**







| Name of<br>Entity | Current Status  | Path Forward   |
|-------------------|---|--|
| ZBB               | Collaboration with ZBB and University of Alaska   | Work with ZBB to develop scope of services and schedule of activities                |
| Aquion            | Aquion is planning a grid demonstration at their manufacturing site in Westmoreland, Pennsylvania | Develop relationship with PA. Energy office for their involvement                    |
| SustainX          | SustainX is planning a grid demonstration at their manufacturing site in New Hampshire            | Develop testing plan   |
| Enervault         | Working with Enervault<br>to develop project with<br>state entity                                 | Find State energy entity that want to be involved in a energy storage demonstration. |

- Project Scope Develop collaborations with State entities to conduct energy Storage demonstrations. Sandia/DOE will provide technical consulting, data collection, analysis and issue report of findings.
- Goal Increase state energy offices' awareness of EES.
- Secondary Goal To support FOA 36 sect
   2.5\_Innovative technologies through their
   "Second Valley of Death."

## EES Emerging Technology Demonstrations Presentation Schedule Milestones





| Name of Project                            | FY13 Milestones  |  |
|--|--|--|
| Fort Devens; Massachusetts                 | Q1 – RFI received & Vendors selected; Q2 – Testing commences.  |  |
| SunPower; California                       | Q1 – Evaluation of ICE Energy system; Q2 – commissioning of ZBB system   |  |
| University of Cal/San Diego;<br>California | Q1/Q2 – Specify and procure ESS; Q3 – Installation and commissioning of ESS; Q4 – Operation  |  |
| Texas Tech University; Texas               | Q1/Q2 – Specify and procure ESS; Q3 – Installation and commissioning of ESS; Q4 – Operation  |  |
| Mesa del Sol; New Mexico                   | Q1/Q2 – Modeling of systems. Q2 – Begin testing  |  |
| Fort Hickam; Hawaii                        | Q1 – Commissioning of system and commence testing and evaluation   |  |
|  |  |  |
| CESA                                       |  |  |
| University of Alaska; Alaska               | These projects represent an inter-laboratory and multi-state arrangement. The day-to-day and periodic milestones are based on vendors – and state entity relationships and will report quarterly on their progress toward their individual energy storage demonstration goals that have been approved. |  |
| Aquion; Pennsylvania                       |  |  |
| SustainX; New Hampshire                    |  |  |
| CESA; Vermont                              |  |  |

# EES Emerging Technology Demonstrations Concluding Remarks





- There are different energy storage technologies that continue to advance. We continue to learn how to help those in the electric utility industry, academia, and research and development to encourage investment, overcome technical challenges, and provide the right skill mix in developing energy storage projects.
- Even after nearly two decades of demonstrations, the variety of projects in this overview are still needed to move new products to commercialization with important benefits such as:
  - Independent third party
    - Verification, testing and analysis
  - Technology clearinghouse for vendors, users, and industry of emerging storage technologies. An we develop a confidence in how to meet requirements for the new and different services that electrical energy storage provides.
- Demonstration projects require EES to be forward thinking and become engaged in establishing industry standards and protocols for new, innovative approaches to encourage the electric utility industry to improve, expand, and grow with changing customer needs.

### Innovation







One of the first Gasoline power cars built ~1891 by Henry Nadig, Allentown, PA.

Courtesy of American Automobile Museum, Allentown, PA.



Courtesy of American Automobile Museum, Allentown, PA.

## Quotes from the day in 1891\* **WENERGY**





- Blasted as a "dangerous device" backfiring caused fires
- Car not allowed on the streets during the day as it "frightened" the horses
- Constable served notice and were liable for arrest for creating a "public nuisance"
- "Shouts of 'get a horse' were followed by **Flying Cabbages** thrown at the hapless Nadig"

<sup>\*</sup> Whelan, Frank "Did Auto Age First Dawn in the Valley? Allentown Mechanic Built One of Country's First Gas-powered Cars" Sept, 14, 1989 The Morning Call





## Thank You and Once Again a Thank You to the OE and Especially Dr. Gyuk for his Dedication and Support to the ES Industry and Sandia's ES Program.

### **Questions?**

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